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CHEMICAL & ENGINEERING

NEWS

Scientific techniques prove "ancient" ceramics are fake
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CHEMICAL & ENGINEERING
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News of the Week

■ **American Medical Association and Senate bill join recent calls for comprehensive national effort for the control and prevention of AIDS.** **Page 6**

■ **Supreme Court decision striking down Louisiana's 1981 creationism law is met by elation, relief, and caution in the scientific community.** **Page 7**

■ **Dainippon Ink & Chemicals offers to buy Reichhold Chemicals, in a deal that would be worth $473 million.** **Page 8**

■ **Colorado likely will become first state to restrict gasoline use, as it attempts to comply with Clean Air Act's carbon monoxide standard.** **Page 8**

■ **A number of chemists were among recipients of national science and technology medals, the nation's highest honor for achievements in science, which were awarded by President Reagan last week.** **Page 8**

Business

Matheson Gas Products, founder of the U.S. specialty gases industry, reorganizes its operation in effort to regain its sales leadership. **Page 11**

Market for silicone fluids, which are used as replacements for PCB-containing fluids in electric transformers, remains strong. **Page 12**

Wellman, a small, successful fibers producer, decides to go public with an offering of 4.9 million common shares. **Page 14**

Government

Falsification of drug reports at Federal Aviation Administration lab brings new cries against increased drug testing of federal workers. **Page 19**

Private-sector whistle-blowers on health and safety issues need stronger and more consistent federal protection, says government report. **Page 20**

Science

The search for drugs to retard AIDS virus is yielding a wide variety of chemical substances, some of which show promise. **Page 25**

Technology

Thermoluminescence technique, used to date ceramics, exposes pieces long thought to be pre-Columbian as modern. **Page 28**

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Salary Survey

Unemployment among chemists was down last year; however, median salaries surprisingly showed little or no growth. **Page 33**

people closer to customer locations. Prospects for distributorships include welding supply companies that now sell industrial gases. Such companies may welcome opportunities to expand beyond their declining industrial accounts to reach high-technology firms, hospitals, and universities.

Matheson will show new distributors how to store, ship, and use specialty gases. Matheson salespeople will join those of distributors in calls on new customers. And the firm will license its technology for repackaging of specialty gases to distributors, thus giving them a share of profits from this value-added step.

In addition to this transfer of technology, Matheson will give customers the benefits of its experience in handling specialty gases. For example, Matheson's experience in destroying toxic gases may be valuable to customers whose process effluents contain such gases. In particular, the company has developed canisters to destroy gases catalytically, thus replacing alternative scrubbing techniques. Matheson also has developed personnel exposure monitors, leak detectors, and remote gas-sensing devices.

Matheson will offer a variation of its in-house computer program used to keep track of cylinder serial numbers, contents, batch numbers, and shipping histories over the past few decades. The program is available on diskettes that operate on IBM-PC microcomputers. Data from the program can be transferred to Lotus 1-2-3 or dBase.

In an expansion of its product line, Matheson acquired Isotec of Centerville, Ohio, in 1986. Isotec produces stable isotopes of carbon, nitrogen, oxygen, and the rare gases by cryogenic fractionation. These isotopes are useful as tracers and in manufacture of radiopharmaceuticals.

Stephen Stinson, New York

Market for silicone PCB substitutes stays large

When Congress passed the Toxic Substances Control Act of 1976 (TSCA), it set into place a national mandate to eliminate the use of polychlorinated biphenyls (PCBs). And at a recent seminar for the press in New York City, Dow Corning, one of three primary producers of silicone fluid replacements for PCB-containing dielectric fluids in electric transformers, presented expert opinion and testimony regarding the legal, practical, and scientific rationale for replacing PCB fluids with silicones.

PCBs have been implicated as a cause of human skin and liver disease, and of cancer and birth defects in laboratory animals. They persist in the environment and tend to concentrate in living tissue.

TSCA "is the first and only time that Congress has identified a specific compound in environmental law," Jack Pulley, Dow Corning's managing counsel of administrative law, told the seminar. As a result, "PCBs have become the focus of more regulatory attention than any other compounds in history. The Environmental Protection Agency and other federal agencies have touched on PCBs 190 times during the past three and a half years alone," Pulley said.

Transformer owners who fail to follow the confusing array of regulations regarding servicing of existing PCB-containing equipment or the removal and proper disposal of PCBs from units being taken out of service are subject to "civil penalties of up to $25,000 per day of violation and criminal sanctions of up to one year in jail per day of violation," according to Pulley.

The replacement of PCB-containing equipment has turned into a substantial business for the manufacturers of replacement fluids with good dielectric properties in wet-type transformers. And according to William C. Page, a senior product market specialist with Dow Corning, that has meant that about 45,000 PCB-containing transformers have been replaced since the first commercial sales of silicone dielectric fluids for transformers began some 13 years ago.

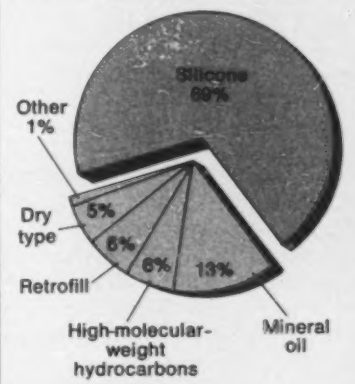
With an average of 230 to 300 gal of dielectric fluid contained in an average transformer, that has meant that since 1974 Dow Corning, Union Carbide, and General Electric have supplied 10.4 million to 13.5 million gal of silicone-type fluids as either direct replacements in PCB-contaminated units or for use in new transformers.

Dow Corning believes the supply of silicone dielectric fluids required to supply replacements of PCB-containing transformers in the next few years is about twice as large as the industry has already seen, said Page. Dow's own silicone fluid for transformers is DC 561, a trimethyl end-blocked polydimethyl siloxane fluid.

Of the four major markets for silicone dielectric transformer fluids, Page said he believes that electrical utility changeover has crested and is on its way down because EPA guidelines have made it mandatory for the utilities to act first. A huge market for replacement of transformers in government facilities is only now beginning to grow, whereas the market for replacing transformers in industrial settings might not take off until much later, he said. The number of installations required because of new construction is relatively small, Page said.

Among the outside consultants Dow Corning tapped at its press seminar, Harry Onishi, an engineer-

Silicone tops replacements for PCBs in transformers



Total number of cases 1985 = 10,511[a]

a Replacements for PCB-containing transformer fluids in electric utility power grids.
Source: Dow Corning

ing manager for Commonwealth Edison of Chicago, said that company has embarked on a $250 million program designed to end the utility's dependence on PCB-containing transformers. Of a total 2400 units containing PCBs in the utility's system, more than 900 units containing silicone dielectric fluid had been installed by April this year.

Commonwealth Edison and other utilities made an industrywide effort to investigate replacements for PCB-containing transformers. The most likely replacements, Onishi said, were "silicone oil transformers, hydrogenated paraffin oil transformers, gas cooled or dry-type transformers, mineral oil transformers, and perchlorethylene transformers." He added that "silicone oil exhibited very acceptable fire-resistant properties during staged catastrophic-fire tests, and its electrical properties and operating requirements do not place undue or unique demands on users." Onishi estimated that industrywide, utilities would be spending billions of dollars to make the switchover mostly to silicone-containing transformers.

According to Eric T. Naschold Jr., an electrical engineer and partner in the Roanoke, Va., consulting firm Hayes, Seay, Mattern & Mattern, if a client decides to replace a PCB-containing transformer, he has a number of options. Standard mineral oil units are a good choice for locations with suitable fireproof vaults, said Naschold, who has worked closely with a number of government agencies in the Washington, D.C., area.

Some customers, he said, opt for dry-type transformers at costs generally lower than those for liquid transformers. "However, standard dry-type transformers are not suitable for use outdoors or in dirty locations and do not provide the same degree of insulation associated with standard liquid transformers." Naschold added that higher-cost, more sophisticated dry transformers do have applications in dirty locations and where high overload capacity is required, though he admitted that operating costs for these units can be 1.5 times greater than such costs for liquid transformers.

Marc Reisch, New York

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Unemployment Is Down This Year for Chemists

Salaries seem to show little or no growth from a year ago when looked at broadly, but the lack of gain may be more apparent than real so far as individuals are concerned

The good news from this year's survey by the American Chemical Society of the economic status of its members: Unemployment among chemists is about a third lower than it was a year ago. As of last March, only 1.1% of ACS chemists were jobless but looking for work, down from 1.7% in March 1986. The rate of unemployment has not been so low since 1981, and the only year since 1971 that it has been lower is 1980, when it fell to 0.9%. Unemployment is about equally down across the board—for both men and women, and both minority and nonminority individuals, as well as for holders of B.S., M.S., and Ph.D. degrees.

The surprising news from the survey: Salaries, overall, seem little, if at all, changed this year from a year ago. The median salary reported by chemists who hold no more than an undergraduate degree is only 2% higher than in 1986; that for chemists with an M.S. is up 3%. For both, the increase is relatively slight, compared with previous gains over the past couple of decades. Even more unusual, the median salary for Ph.D. chemists is essentially unchanged, as is that for all chemists whatever their degree. Such a result is unprecedented in the nearly 20 years that ACS has been making similar annual surveys of members' salaries. Previously, the median salaries of Ph.D.s had grown steadily throughout two decades.

Because growth in salaries apparently has hit a snag, chemists gen-

Unemployment is low for all ACS members, and especially so for those with Ph.D.s

	Chemists									
		By sex		By highest degree			By minority status		Chemical	All
Employment status[a]	Total	Men	Women	B.S.	M.S.	Ph.D.	Minority[b]	Nonminority	engineers	members[c]
Employed full time	94.4%	95.4%	89.3%	94.9%	94.6%	94.1%	92.7%	94.6%	93.9%	94.0%
Employed part time	1.5	1.1	3.6	1.6	2.1	1.3	1.2	1.5	2.1	1.6
Postdoctoral or fellowship	2.0	1.7	3.0	0.3	0.1	3.2	4.5	1.7	0.4	1.7
Unemployed										
Seeking employment	1.1	1.0	1.5	1.7	1.3	0.8	1.3	1.1	1.6	1.4
Not seeking employment	1.0	0.7	2.6	1.5	1.9	0.6	0.3	1.1	2.0	1.2

a As of March 1, 1987. b Black, Hispanic, American Indian, Alaskan native, Asian, Pacific Islander, or other. c Includes ACS members whose highest degree and present work are in neither chemistry nor chemical engineering. **Source:** ACS survey

Increases in salaries for chemists were subpar or nonexistent last year

											Annual change		
$ Thousands	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1986–87	1982–87	1977–87
CHEMISTS' MEDIAN SALARIES[a]														
B.S.	$33.5	$33.0	$32.0	$30.9	$30.0	$28.5	$27.5	$25.0	$23.5	$22.0	$21.0	2%	3%	5%
M.S.	39.0	37.9	36.0	34.0	33.0	31.6	30.0	26.0	25.0	24.0	22.0	3	4	6
Ph.D.	47.7	47.8	44.0	42.0	40.0	37.5	35.0	31.2	29.0	27.4	26.0	0	5	6
All chemists	42.5	42.5	40.0	38.0	36.0	34.7	32.0	28.9	na	na	na	0	4	na

a Base annual salary as of March 1, 1987. na = not available. **Source:** ACS survey

An increase in responsibility brings its rewards

The amount of responsibility that chemists exert in doing their work is likely to be reflected in how much they are paid.

This year, for the first time, the annual economic survey of ACS members included a battery of questions designed to indicate the degree of responsibility with which individual respondents perform their assignments. Responsibilities were grouped into four categories: duties (the complexity of projects undertaken), technical decisions and recommendations (the scope of responsibility for technical matters handled), the amount of supervision received, and the amount of supervision exercised.

Respondents were asked to rank the level of responsibility they exercised within each of these categories on a scale of one to five, with one being the level of least responsibility. Thus, the overall level of an individual respondent's responsibility can be ranked on a scale from four (scoring one for each of the four responsibility categories) to 20 (scoring five for each of the four categories).

A chemist with a score of four, for example, works only on simple projects or in assisting senior staff, makes decisions regarding only minor technical details, works under detailed instructions and close guidance, and has no authority over others' work. At the other end of the scale, a chemist with a score of 20 has full managerial authority over an operation, including budgeting and long-term planning, has full responsibility for projects, including the authority to delegate responsibility to others, is unsupervised except within broad organizational policy guidelines, and has full control over senior staff who, in turn, may have authority over smaller groups of employees.

A chemist with a midrange responsibility score of 12 typically plans and handles projects of moderate complexity, is responsible for the technical aspects of these projects with only occasional review for effectiveness, is assigned only broad objectives and priorities for projects, and supervises a group of professional subordinates and technicians.

As the accompanying table—which pertains only to chemists working in private industry—indicates, increased responsibility clearly pays off with increased income. Among chemists whose highest degree is a B.S., the median salary of those in the top range of responsibility scores is double that of those in the bottom range, for example. Ph.D. chemists in the top range similarly have a 60% salary advantage over those at the bottom. Very few Ph.D.s, however, rank at that low level.

As might be expected, in fact, the responsibility rankings of chemists with a Ph.D. tend to be well above those of their colleagues who lack a Ph.D.; 55% have a score higher than 12, compared with only 42% of those with an M.S. and 38% of those with no higher degree than a B.S. The difference in scores between M.S. and B.S. chemists, though, is only slightly to the advantage of those with the higher degree.

The table also indicates that women chemists are considerably less likely than men to hold down a highly

Length of experience is a bigger factor in determining salary early in a chemist's career

Years since B.S. degree	Median salary ($ thousands)[a]										
	0 to 1	2 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	Overall
NONACADEMIC CHEMISTS											
B.S.											
90%	$28.5	$31.2	$38.0	$46.6	$53.5	$58.0	$60.0	$67.6	$70.8	$56.0	$54.0
75%	25.0	28.0	35.0	40.1	45.0	52.0	53.0	58.9	59.5	51.0	44.0
50%	23.0	25.0	30.0	34.5	39.0	43.0	45.4	48.0	50.0	42.0	34.0
25%	18.7	21.3	25.5	30.0	33.0	35.0	39.0	42.1	40.0	33.0	27.0
10%	18.0	18.1	22.0	26.0	28.0	29.0	30.3	33.3	33.2	24.0	22.3
M.S.											
90%	—	39.5	40.0	48.3	58.5	62.4	70.0	66.0	84.0	95.0	61.3
75%	—	32.5	35.0	43.0	50.0	52.7	61.5	58.0	64.9	62.5	50.0
50%	—	29.0	31.2	37.5	42.7	44.7	50.0	48.5	52.5	53.0	40.8
25%	—	24.0	27.4	32.0	35.5	37.9	42.5	39.0	41.6	48.5	32.5
10%	—	22.0	23.5	28.0	31.1	30.0	37.5	32.0	32.6	38.0	27.5
Ph.D.											
90%	—	—	47.0	55.0	65.0	74.0	87.0	89.4	92.5	80.0	75.0
75%	—	—	43.0	50.1	58.7	65.0	70.5	73.0	76.0	73.4	62.4
50%	—	—	40.3	45.0	52.0	56.0	60.0	60.7	63.5	60.0	52.0
25%	—	—	38.0	40.7	45.0	49.0	51.6	50.5	52.0	51.7	43.7
10%	—	—	35.4	37.1	40.0	42.0	44.6	44.6	44.8	40.0	39.0

a As of March 1, 1987. **How to read this table:** Using, as an example, nonacademic B.S. chemists two to four years after having received their B.S. degree, 90% of these chemists have annual base salaries of $31,200 or less, 75% have annual base salaries of $28,000 or less, 50% have annual base salaries of $25,000 or less, 25% have annual base salaries of $21,300 or less, and 10% have annual base salaries of $18,100 or less. **Source:** ACS survey

Salaries increase markedly with level of responsibility

Responsibility score	% with score			Median salary ($ thousands)		
	All chemists	Men	Women	All chemists	Men	Women
CHEMISTS EMPLOYED FULL TIME IN INDUSTRY						
B.S.						
4 to 8	16%	14%	25%	$26.0	$26.0	$26.2
9 to 12	46	44	53	33.0	35.0	30.0
13 to 16	27	29	20	40.0	40.0	35.0
17 to 20	11	14	2	52.2	53.0	35.0
M.S.						
4 to 8	12	11	18	32.0	32.0	32.5
9 to 12	46	44	53	38.5	40.3	34.2
13 to 16	30	31	26	46.0	48.0	43.0
17 to 20	12	14	3	58.4	58.8	55.0
Ph.D.						
4 to 8	3	3	6	42.5	42.6	41.2
9 to 12	42	41	53	47.0	48.0	42.0
13 to 16	39	39	37	55.0	55.0	47.0
17 to 20	16	17	4	67.5	68.0	60.1

Source: ACS survey

responsible post. A mere 3% of the women responding to the ACS survey indicate they hold jobs with a score higher than 17, compared with 16% for men. On the other hand, 18% of the women but just 7% of the men have scores less than 8. This may, at least in part, explain why salaries for women chemists tend to be lower than those for men.

One reason why women may score lower, of course, is that as a group they tend to be younger, and hence less experienced. Not surprisingly, responsibility scores rise as length of experience increases. Thus less than 10% of the Ph.D. chemists who earned their undergraduate degree less than 20 years ago score above 16 in responsibility, but 23% of those who received their B.S. degree 30 or more years ago rank that high. Likewise for chemists whose highest degree is a B.S., only 6% of those who graduated less than 20 years ago score higher than 16, but 25% of those who received their degree 30 or more years ago rank above 16.

Even so, age and length of work experience do not appear to be the sole reason that women seem underrepresented among chemists with the highest responsibility. For example, adjusting the responses from chemists with a Ph.D. for differences in length of experience, if women otherwise were as likely as men to attain a responsibility score higher than 16, approximately 12% rather than 4% would rank that high. Similarly, about 8% of women with a B.S. degree would have a responsibility score of more than 16, rather than the 2% that the survey shows, if the survey responses were weighted for differences between men and women in years of experience.

erally appear to be worse off now than they were a year ago if income is compared with living costs. Although consumer prices last March were only 3% higher than a year earlier, median salaries, in constant dollars, for B.S. chemists are 1% lower and those for Ph.D.s are down 3% from March 1986. This year will be the first time since 1980 that the increase in median salary for Ph.D.s has not outpaced the rise in living costs. Median salaries for B.S. chemists, on the other hand, have been down more often than not during the past 10 years, after adjustment for inflation. Consequently, the overall median for them this year is 15% lower than it was 10 years ago.

This year's lack of growth in salaries may be more apparent than real, however, at least so far as individual chemists are concerned. A closer look at the survey results provides further insight into what may be behind the poor appearance of the broad figures. The picture certainly is more favorable if smaller, more discrete groups are used for year-to-year salary comparisons.

For one thing, academic salaries do not seem to have fared poorly. Median salaries earned by Ph.D. chemists at universities and colleges are higher at all professorial levels—generally 5% or more—both in schools with graduate programs and in those without.

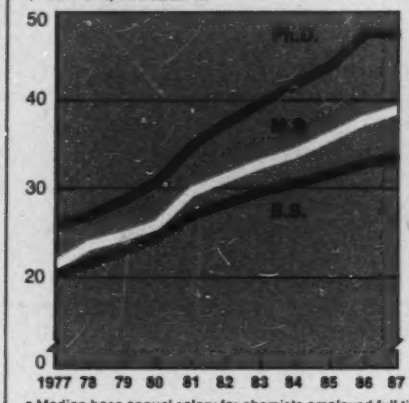
A look at median salaries of nonacademic chemists, split up into smaller groups based on length of time since they received their B.S. degree, also indicates that most such groups are earning more now than a year ago. This suggests that although median salaries for nonacademic chemists overall may have shown little or no growth, the salaries of individual chemists in most cases actually have increased.

One factor that probably has depressed the overall salary medians is that this year's survey respondents, as a whole, are less experienced than respondents in 1986. For example, among chemists working in industry—where 61% are employed—19% of the respondents this year had earned their baccalaureate degree 30 or more years ago, down from 21% in 1986. At the same time, 43% of the industrial chemists in this year's survey received their B.S. in the past 14 years, up from 40% last year.

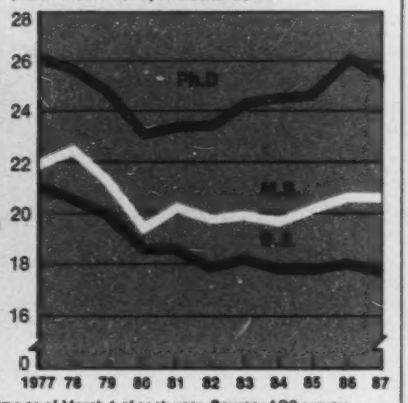
Staff reduction and early retirement programs have been widespread throughout the chemical process industries during the past two or three years as companies have strived to trim costs, divest low-profit operations, and revamp corporate structures. Older chemists often have been especially hit by these moves. This, in turn, may well account for the decrease in the numbers of older industrial chemists, who tend to have higher salaries, relative to the ranks of their younger colleagues, who are likely to earn less.

This year's survey shows no appreciable narrowing of the gap that

Growth in chemists' salaries faltered last year . . .



. . . especially after adjustment for inflation



a Median base annual salary for chemists employed full time as of March 1 of each year. **Source:** ACS survey

generally exists between salaries earned by men and those earned by women. Because women chemists, on the average, are younger and less experienced than their male counterparts, a meaningful comparison between the two groups requires that mean salaries for women be adjusted to compensate for this age/experience bias.

When salaries are so adjusted, however, a gap—typically ranging between 10 and 20%, depending on highest degree and type of employer—still exists in favor of men. The gap, moreover, has shown no evidence of narrowing in recent years. And it is just as evident for women who work for government or academic employers as for those with jobs in private industry.

As has been the case for several years, the gap between salaries of women and men chemists is quite small during the early stages of their careers. For men chemists with a B.S. and working in industry, for example, the median salary is 7% higher if they have been working for just four years or less and only 3% higher if they have been working between five and 14 years. But for B.S. industrial chemists with longer experience than that, the median for men's salaries is more than 20% higher than that for women's salaries. Similarly for Ph.D.s in industry, the difference between the median for men and that for women is very slight among those who obtained their undergraduate degree less than 20 years ago, but for those with more experience, the median for men also is more than 20% greater.

The discrepancy between salaries

Ph.D.-granting schools pay higher salaries, especially for more experienced professors

Years since B.S. degree	Median salary ($ thousands)[a]								
	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	Overall
Ph.D. CHEMISTS EMPLOYED FULL TIME IN ACADEMIA									
Ph.D.-granting schools									
Professor	—	—	$56.9	$54.9	$61.0	$62.2	$63.4	$68.9	$61.0
Associate professor	—	($41.5)	42.0	42.0	(41.8)	—	(43.3)	—	42.0
Assistant professor	$34.0	35.4	(36.1)	—	—	—	—	—	35.0
All ranks[b]	32.9	36.0	42.4	48.7	56.6	60.5	58.7	67.1	48.8
Non-Ph.D.-granting schools									
Professor	—	—	(43.8)	43.6	49.0	49.0	51.2	50.0	48.2
Associate professor	—	(34.2)	36.5	38.5	(37.0)	(38.4)	(39.5)	(41.2)	37.6
Assistant professor	28.1	30.5	32.2	(33.9)	—	—	—	—	30.5
All ranks[b]	27.8	30.5	35.1	40.3	46.4	48.2	49.7	47.6	41.0

Note: Where no salary data are shown, sample is too small to provide a meaningful figure; data in parentheses are from relatively small samples, as well, and should be viewed with caution. a As of March 1, 1987; salaries of academic chemists with nine- or 10-month contracts are adjusted to a 12-month basis. b Includes instructors, lecturers, research associates, and others not listed separately. **Source:** ACS survey

Women chemists are likely to earn less than men wherever they work

Mean salary, $ thousands[a]	B.S.				M.S.				Ph.D.			
	All chemists	Men	Women	Women as % of men	All chemists	Men	Women	Women as % of men	All chemists	Men	Women	Women as % of men
EMPLOYER												
Private industry	$37.4	$39.4	$34.3	87%	$43.8	$45.4	$39.7	87%	$55.7	$56.4	$49.2	87%
Academic	24.4	26.6	22.3	84	29.9	31.9	27.4	86	41.3	42.3	36.1	85
Government	34.5	36.5	30.6	84	35.9	36.8	33.7	92	50.2	50.9	41.8	82
Other	33.6	36.9	28.4	77	42.0	46.7	35.9	77	53.5	54.5	50.2	92

a As of March 1, 1987; to facilitate comparison, women's salaries are adjusted for the difference in average length of experience between them and men. **Source:** ACS survey

Industrial chemists earn more if they work as managers

Years since B.S. degree		Median salary ($ thousands)[a]										
		0 to 1	2 to 4	5 to 9	10 to 14	15 to 19	20 to 24	25 to 29	30 to 34	35 to 39	40 or more	Overall
CHEMISTS EMPLOYED FULL TIME IN INDUSTRY												
Sex												
Men	B.S.	$23.5	$26.0	$30.8	$34.8	$40.9	$47.5	$46.8	$49.0	$50.0	$43.2	$36.4
	M.S.	—	32.0	33.0	38.0	43.8	45.0	51.2	51.0	54.9	56.0	42.5
	Ph.D.	—	—	41.0	45.4	52.0	59.0	63.1	64.0	66.9	65.5	53.0
Women	B.S.	(22.0)	24.4	30.0	33.7	32.0	(38.7)	(39.0)	(40.5)	(47.2)	—	30.0
	M.S.	—	(27.0)	31.5	38.0	40.1	(43.8)	(45.0)	(38.0)	—	—	35.0
	Ph.D.	—	—	40.0	44.6	53.2	47.0	(51.2)	—	—	—	44.8
Work function												
General management	B.S.	—	(28.0)	36.0	(36.9)	(47.4)	(50.0)	(52.9)	(55.0)	70.6	—	45.0
	M.S.	—	—	(34.0)	(41.9)	(63.0)	—	—	—	(70.0)	—	48.5
	Ph.D.	—	—	—	—	(61.8)	(67.7)	(60.0)	—	(65.0)	—	63.5
R&D management	B.S.	—	—	(38.0)	(45.0)	(46.5)	52.2	(51.8)	(60.0)	56.1	—	50.5
	M.S.	—	—	—	44.0	(53.0)	60.0	62.0	(62.5)	(55.5)	(60.0)	55.0
	Ph.D.	—	—	(50.0)	52.0	59.2	65.5	75.5	70.0	81.5	(60.0)	65.0
Basic research	B.S.	—	24.3	29.7	(34.0)	—	—	—	—	—	—	28.0
	M.S.	—	—	32.5	(37.5)	—	(45.4)	—	—	—	—	36.0
	Ph.D.	—	—	41.0	45.0	51.2	55.5	58.0	(62.0)	(68.5)	—	48.0
Applied research[b]	B.S.	(23.7)	26.4	30.0	32.0	40.0	43.5	42.0	48.3	48.4	(42.8)	33.1
	M.S.	—	(31.5)	33.1	40.0	41.6	41.0	45.1	49.0	51.1	(55.5)	40.6
	Ph.D.	—	—	40.3	44.9	49.2	54.1	60.0	59.1	62.0	(58.3)	49.0
Production[c]	B.S.	(22.0)	23.0	27.5	34.0	35.5	34.0	43.0	(43.5)	(41.0)	—	31.0
	M.S.	—	(29.8)	27.4	33.5	42.0	(39.0)	(48.0)	(38.5)	—	—	35.5
	Ph.D.	—	—	(40.4)	(45.0)	(44.2)	(51.0)	—	—	—	—	46.1
Marketing[d]	B.S.	—	—	33.0	37.5	(40.0)	—	(49.0)	(46.8)	(49.9)	—	42.1
	M.S.	—	—	(34.5)	(40.9)	(48.4)	(43.0)	(51.2)	—	—	—	44.2
	Ph.D.	—	—	—	(44.8)	—	(55.2)	(58.5)	—	—	—	52.0
Work specialty												
Agricultural and food chemistry	B.S.	—	—	(28.3)	(43.5)	(33.5)	—	—	—	(48.8)	—	32.3
	M.S.	—	—	(30.3)	(39.0)	(44.8)	—	—	—	—	—	42.5
	Ph.D.	—	—	—	44.1	(52.2)	(53.0)	(65.7)	—	(74.8)	—	52.6
Analytical chemistry	B.S.	(23.4)	24.5	30.0	32.0	36.4	39.9	45.7	43.2	45.0	—	32.2
	M.S.	—	(29.1)	30.4	36.5	41.0	41.0	47.3	(52.5)	(55.0)	—	38.0
	Ph.D.	—	—	41.0	45.0	52.8	56.0	60.0	59.5	62.3	—	50.0
Biochemistry	B.S.	—	—	(29.1)	—	—	—	—	—	—	—	28.7
	M.S.	—	—	—	(33.3)	—	—	—	—	—	—	36.8
	Ph.D.	—	—	(39.6)	46.0	54.0	56.0	(53.3)	(67.5)	—	—	50.0
Environmental chemistry	B.S.	—	22.5	28.0	34.4	(39.8)	(44.0)	(44.2)	—	—	—	31.0
	M.S.	—	—	(32.1)	34.1	(46.4)	—	(46.0)	—	—	—	39.5
	Ph.D.	—	—	—	(44.6)	51.0	57.8	(55.0)	(54.5)	—	—	52.0
Inorganic chemistry	B.S.	—	—	(30.1)	(43.0)	—	—	—	—	(53.5)	—	36.0
	M.S.	—	—	—	—	—	—	—	—	—	—	48.8
	Ph.D.	—	—	(40.0)	45.6	(51.0)	(62.5)	—	—	—	—	49.8
Materials science	B.S.	—	(26.9)	(34.7)	—	(53.5)	(50.2)	—	(48.2)	(56.0)	—	38.9
	M.S.	—	—	(37.5)	(41.5)	—	(47.3)	—	(49.0)	—	—	45.0
	Ph.D.	—	—	(42.0)	48.0	(55.0)	57.5	69.0	(65.5)	70.5	—	55.0
Medicinal and pharmaceutical chemistry	B.S.	—	24.2	28.6	(38.8)	(44.0)	—	—	—	—	—	32.6
	M.S.	—	—	(30.4)	(35.1)	(43.4)	—	—	(42.0)	—	—	39.5
	Ph.D.	—	—	43.0	45.3	49.0	60.0	74.0	(74.4)	(64.4)	—	52.2
Organic chemistry	B.S.	—	(26.5)	28.9	34.5	40.0	(52.0)	(50.0)	(51.5)	(50.0)	—	35.3
	M.S.	—	—	32.5	(36.0)	(41.1)	(45.8)	—	—	(70.0)	—	40.0
	Ph.D.	—	—	40.4	45.0	50.6	58.0	66.0	63.0	67.0	(67.5)	52.0
Physical chemistry	B.S.	—	—	—	—	—	—	—	—	—	—	35.0
	M.S.	—	—	—	—	—	—	—	—	—	—	46.5
	Ph.D.	—	—	(39.0)	(46.4)	56.0	56.0	(71.5)	(66.0)	(75.0)	—	56.0
Polymer chemistry	B.S.	—	26.4	32.0	36.0	(43.9)	47.2	45.2	50.0	54.3	(53.5)	40.2
	M.S.	—	—	36.0	42.5	48.0	(48.0)	(56.0)	(52.2)	(52.0)	—	46.0
	Ph.D.	—	—	40.3	45.0	52.0	59.0	60.0	60.0	63.6	(54.7)	53.0

Note: Where no data are shown, sample is too small to provide meaningful figure; data in parentheses are from relatively small samples, as well, and should be viewed with caution.
a As of March 1, 1987. b Includes development and design. c Includes quality control. d Includes purchasing, technical service, and economic evaluation. **Source:** ACS survey

earned by men and those for women can be at least partially explained by the relatively larger number of men who hold positions of high responsibilty and authority. Even when allowance is made for their younger-than-average age, women are underrepresented in such jobs, where salaries are typically the highest.

This year's decline in unemployment largely is a result of an improved situation for chemists in industry. The jobless rate for industrial chemists dropped this March to 1.4%, from 2.2% a year earlier. Employment remains relatively high for chemists who had been working in production (1.5%) or marketing (1.3%), but nevertheless it is down markedly from last year, when the rate for both groups was 3.5%. The rock-bottom unemployment rates this year for chemists most recently employed in academia (0.8%) or in government (0.4%) are essentially unchanged from those that were reported in 1986.

Although the number of chemists who are unemployed this year is very small, many of those who are out of work have found that the search for a new job is a long one. In fact, 43% of the jobless seeking work last March had been doing so for more than six months and 22% for more than a year. Ph.D.s especially seem to take a long time to find a new position they think suitable; slightly more than half of the relatively few Ph.D. chemists who were looking for a job in March—when the unemployment rate for Ph.D. chemists was a mere 0.8%—had been without work for more than six months.

The same is true for chemists who were unemployed any time during 1986. (This year's survey is the first to inquire whether respondents were without work any time in the previous year, rather than just at the time the survey was being made.) All told, of the chemists who were in the labor force as of last March, 9% had been jobless sometime during 1986. Women were more likely to have been unemployed than men, and chemists who do not have a graduate degree more likely than those who do.

On the other hand, chemists with a B.S. tended to obtain a new position more quickly; about 70% of them found employment in six months or less but slightly fewer than 60% of the unemployed Ph.D.s were able to obtain new work that fast.

These statistics on the current salaries and employment status of

Industrial chemists are most likely to be unemployed

	% of chemists in category	% unemployed[a]
MOST RECENT EMPLOYER		
Industry	61%	1.4%
Academic	24	0.8
Government	9	0.4
Other	6	1.0
MOST RECENT WORK FUNCTION		
R&D	46%	1.3%
Teaching	13	0.5
R&D management	12	1.0
Marketing[b]	8	1.3
General management	6	0.7
Production[c]	4	1.5
Other	12	1.7
MOST RECENT WORK SPECIALTY		
Analytical	21%	1.2%
Organic	13	0.7
Polymer	12	1.6
Biochemistry	8	0.8
Environmental	8	1.1
Physical	7	0.4
Medicinal[d]	6	0.8
Inorganic	4	0.6
Agricultural and food	4	0.7
Other chemistry	16	1.9

a As of March 1, 1987; excludes chemists who are not employed but not seeking employment. b Includes purchasing, technical service, and economic evaluation. c Includes quality control. d Includes pharmaceutical and clinical chemistry. Source: ACS survey

Oil industry offers highest salaries for industrial chemists

Industry	% of industrial chemists: All chemists	B.S.	M.S.	Ph.D.	Mean salary ($ thousands)[a]: B.S.	M.S.	Ph.D.
Pharmaceuticals[b]	18%	17%	20%	17%	$40.3	$42.4	$57.2
Specialty chemicals	15	13	12	16	41.8	45.7	53.3
Basic chemicals	7	4	5	9	40.8	43.8	58.2
Plastics	5	5	6	6	42.3	47.6	56.6
Petroleum and natural gas	5	3	4	6	45.1	49.4	63.6
Agricultural chemicals	4	2	4	5	37.8	46.0	54.4
Coatings	4	5	4	3	41.6	47.7	50.6
Electronics	4	3	4	4	41.2	46.2	56.9
Food	3	5	4	2	39.8	46.2	56.5
Metals and minerals	2	4	2	1	40.2	38.8	47.0
Rubber	2	3	2	2	40.7	37.8	54.7
Biochemical products	2	1	2	2	35.1	35.5	57.5
Soaps and detergents	1	1	1	2	36.3	47.2	59.8
Paper	1	1	1	1	37.2	37.8	54.8
Other manufacturing	17	20	17	16	41.2	44.1	55.1
Nonmanufacturing	10	13	12	7	40.7	41.0	50.1

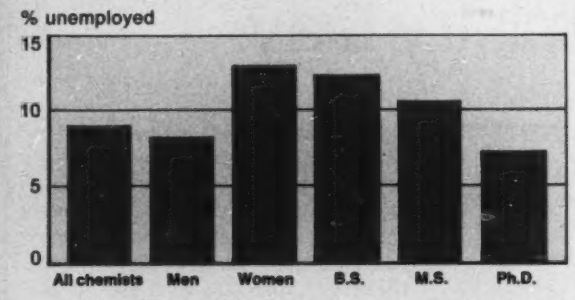
a As of March 1, 1987; to facilitate comparison, mean salaries are adjusted for differences in average length of experience for each group. b Includes personal care products. Source: ACS survey

Unemployment this year has not been so low for chemists since the early 1980s

Employment status[a]	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977
Employed full time	95.4%	94.8%	95.2%	93.7%	93.5%	94.9%	95.6%	95.9%	95.0%	95.7%	95.4%
Employed part time	1.5	1.5	1.5	1.7	1.7	1.4	1.1	1.0	2.0	1.0	1.1
Postdoctoral or fellowship	2.0	2.0	1.9	2.9	2.6	2.2	2.2	2.2	1.9	1.9	2.1
Unemployed	1.1	1.7	1.4	1.7	2.2	1.5	1.1	0.9	1.1	1.4	1.5

a As of March 1, 1987; excludes chemists who are not employed but not seeking employment. Source: ACS survey

Nearly 10% of chemists were unemployed sometime in 1986



Chemists who were unemployed last year often were jobless more than six months

Months unemployed in 1986	Less than 1	1 to 3	4 to 6	7 to 12
All chemists	9%	35%	17%	38%
Men	8	35	17	40
Women	12	37	19	32
Highest degree				
B.S.	11	37	20	32
M.S.	7	39	15	39
Ph.D.	8	32	16	43

Note: Excludes chemists not in the labor force March 1, 1987. **Source:** ACS survey

members of the chemical profession are based on more than 12,000 responses to a mail survey of a random sample of ACS members taken this past March by the ACS Office of Statistical Services, under the aegis of the ACS joint board-council Committee on Economic Status. The survey was limited to U.S. residents who are not students, retired, nor emeritus members and who are less than 70 years old.

Detailed results of the survey will be published by August as four separate reports: "1987 Salaries of Nonacademic Chemists" (price: $75 for ACS members, $150 for nonmembers), "1987 Salaries of Academic Chemists" (price: $50 with no member discount), "1987 Salaries of Nonacademic Chemical Engineers" (price: $50 for ACS members, $100 for nonmembers), and "1987 Employment Status and Demographic Characteristics of ACS Members" (price: $10 with no member discount); all four publications can be purchased at a price of $100 for ACS members or $200 for nonmembers. Orders should be placed with the ACS Distribution Office, Room 210, American Chemical Society, 1155—16th St., N.W., Washington, D.C. 20036; ACS members should include their membership number with their orders. □

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